

SUPPLEMENTARY INFORMATION

Convergent evolution of bilaterian nerve cords

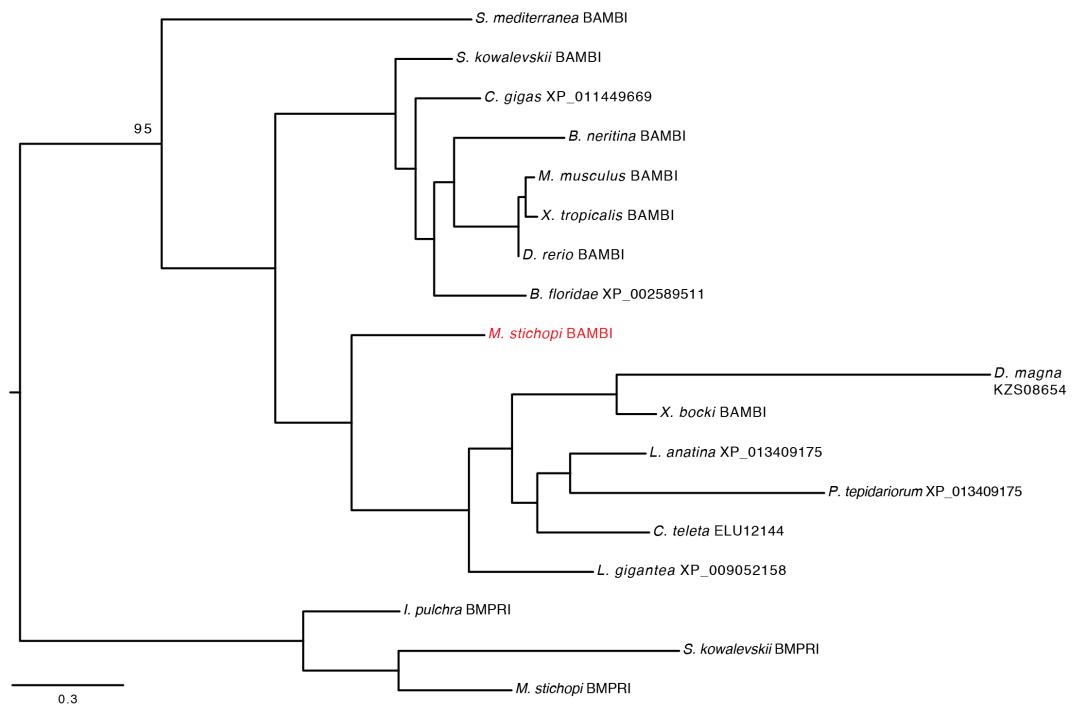
José M. Martín-Durán, Kevin Pang, Aina Børve, Henrike Semmler Lê, Anlaug Furu, Johanna Taylor Cannon, Ulf Jondelius, Andreas Hejnol

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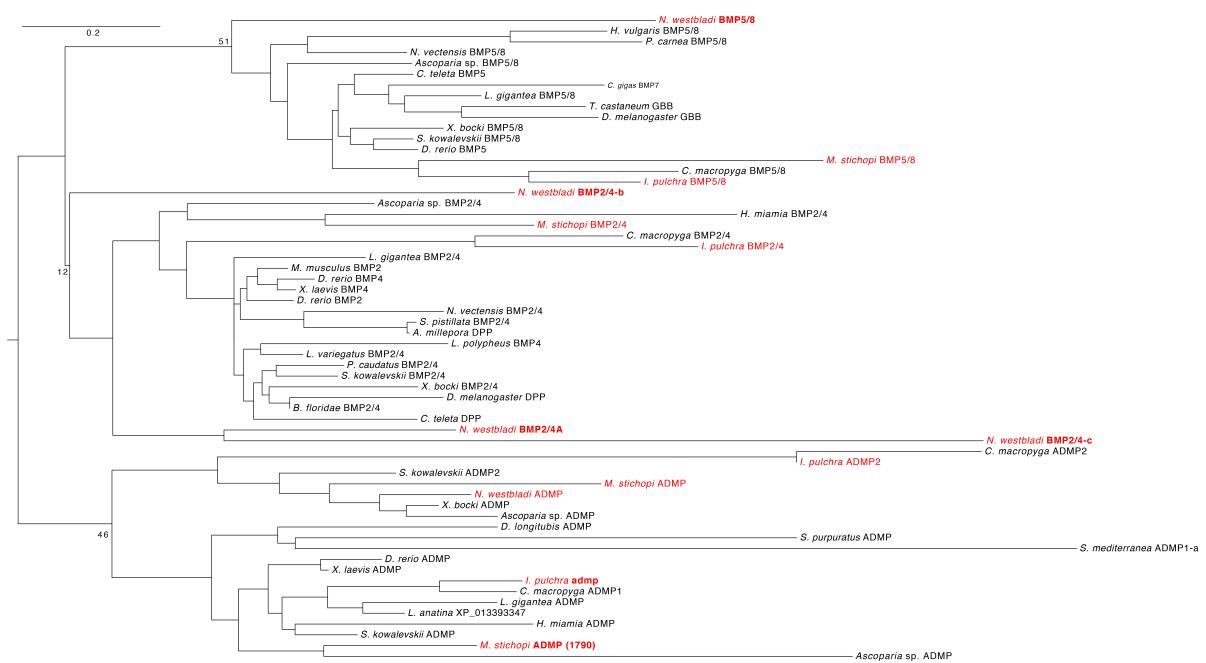
- Supplementary Figure 1
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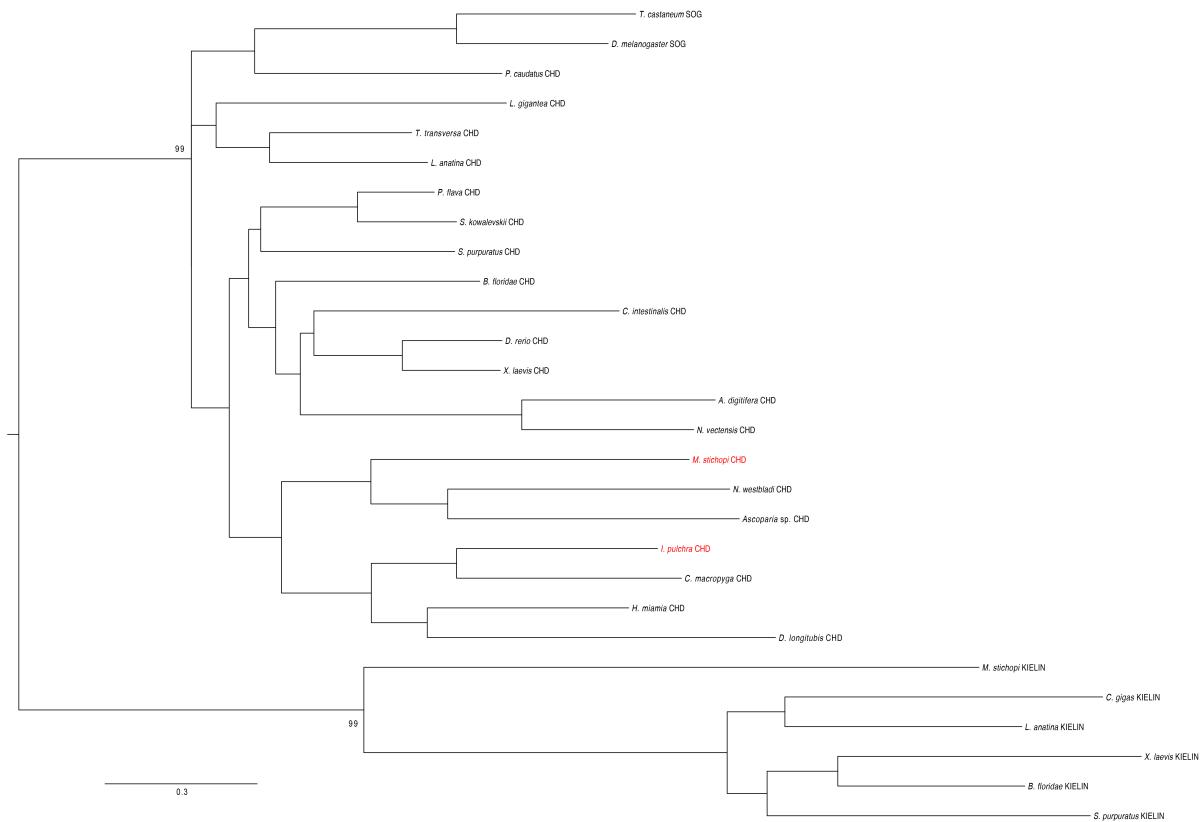
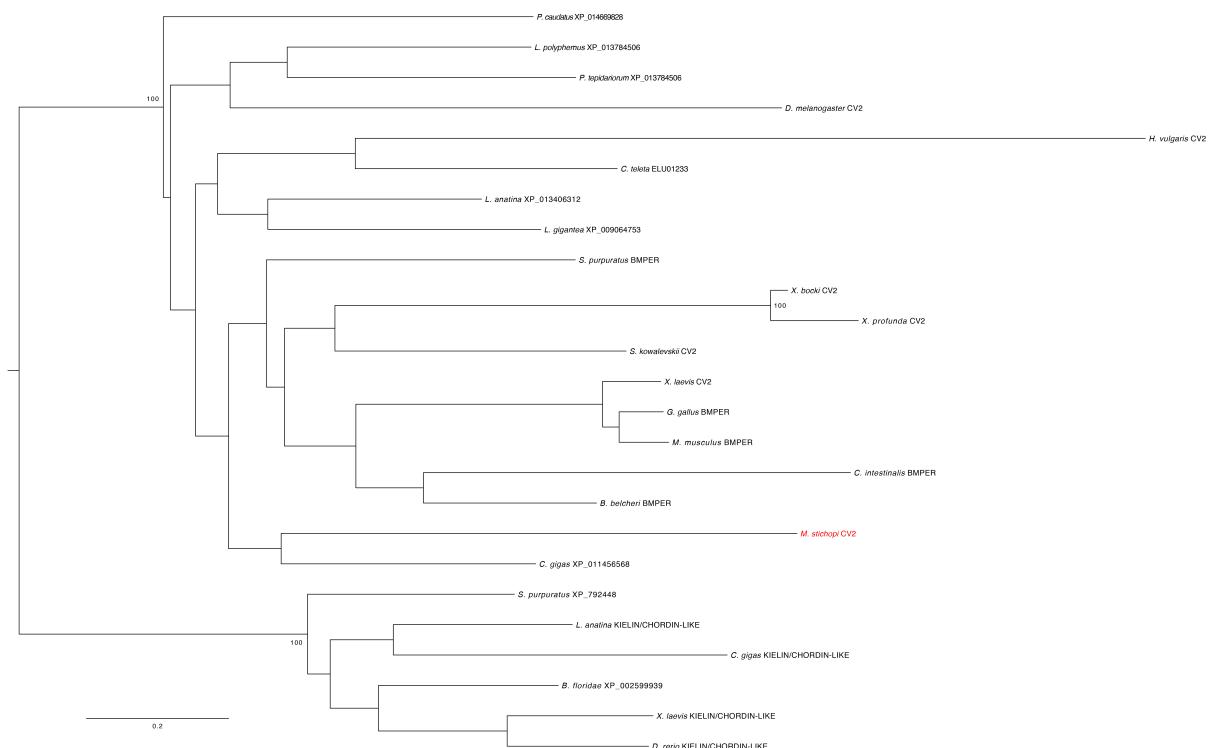
Supplementary Figure

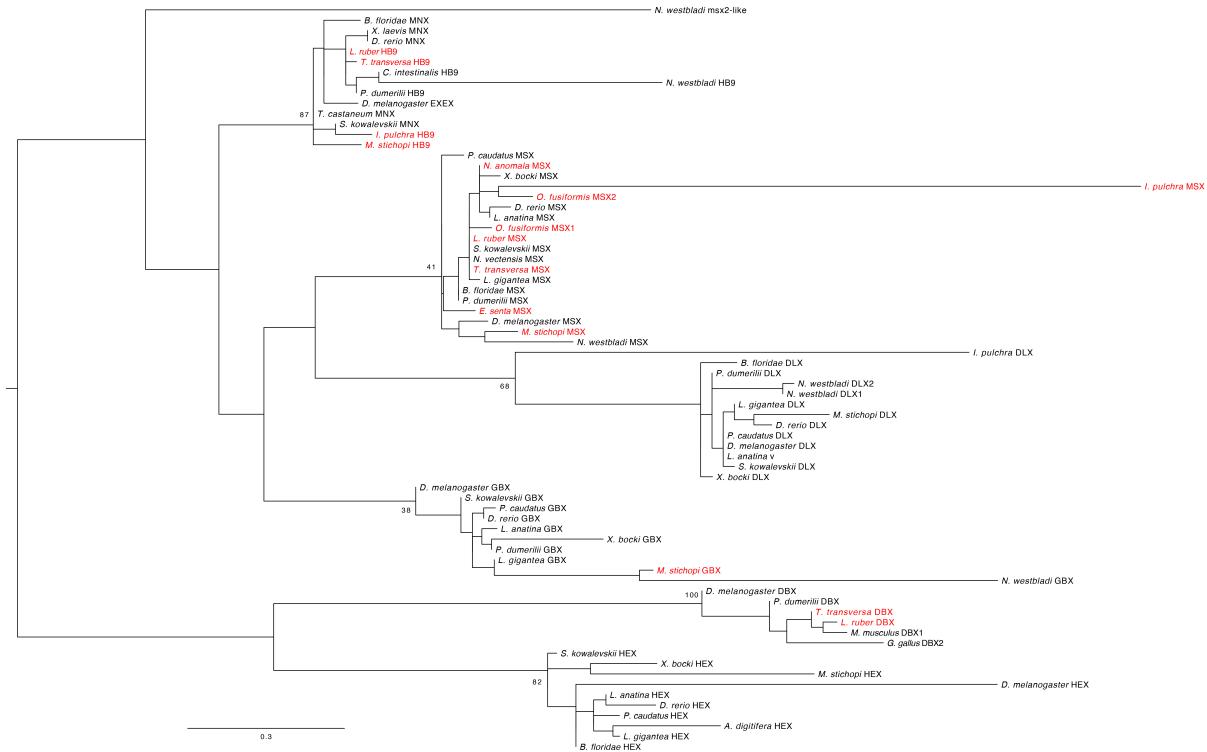
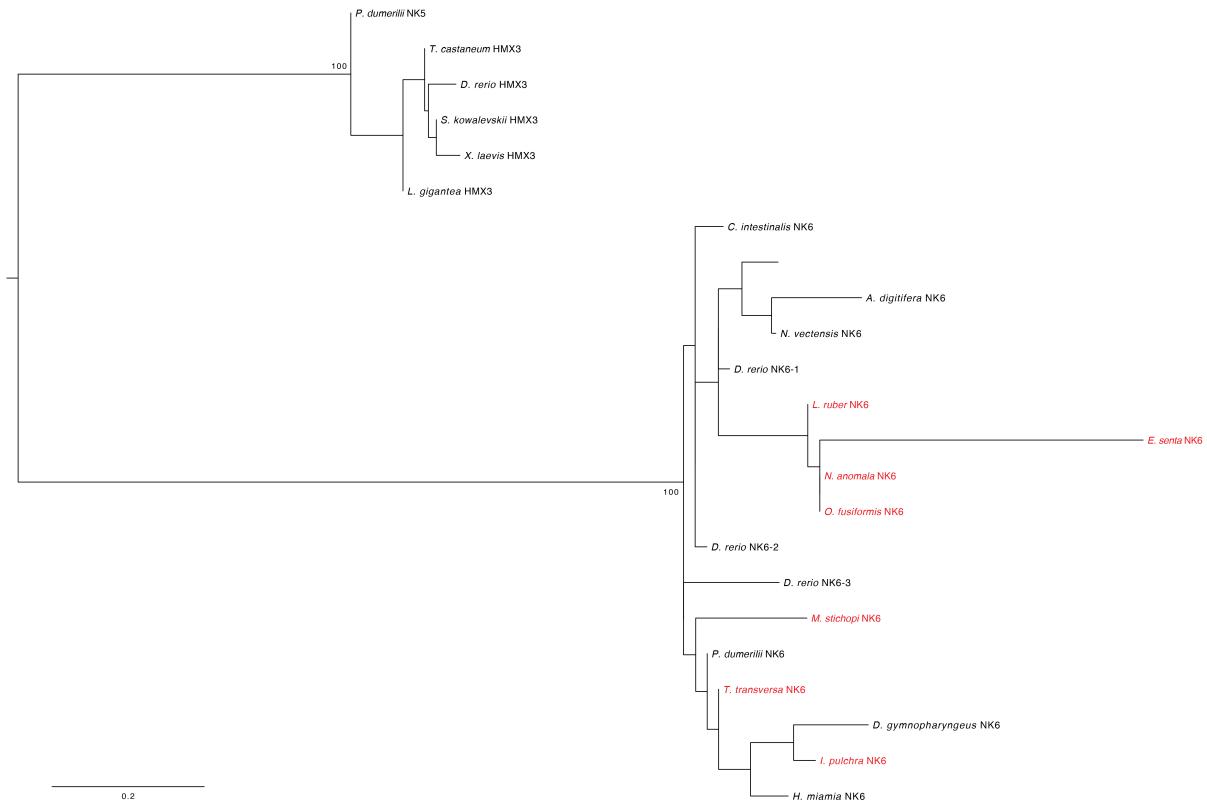
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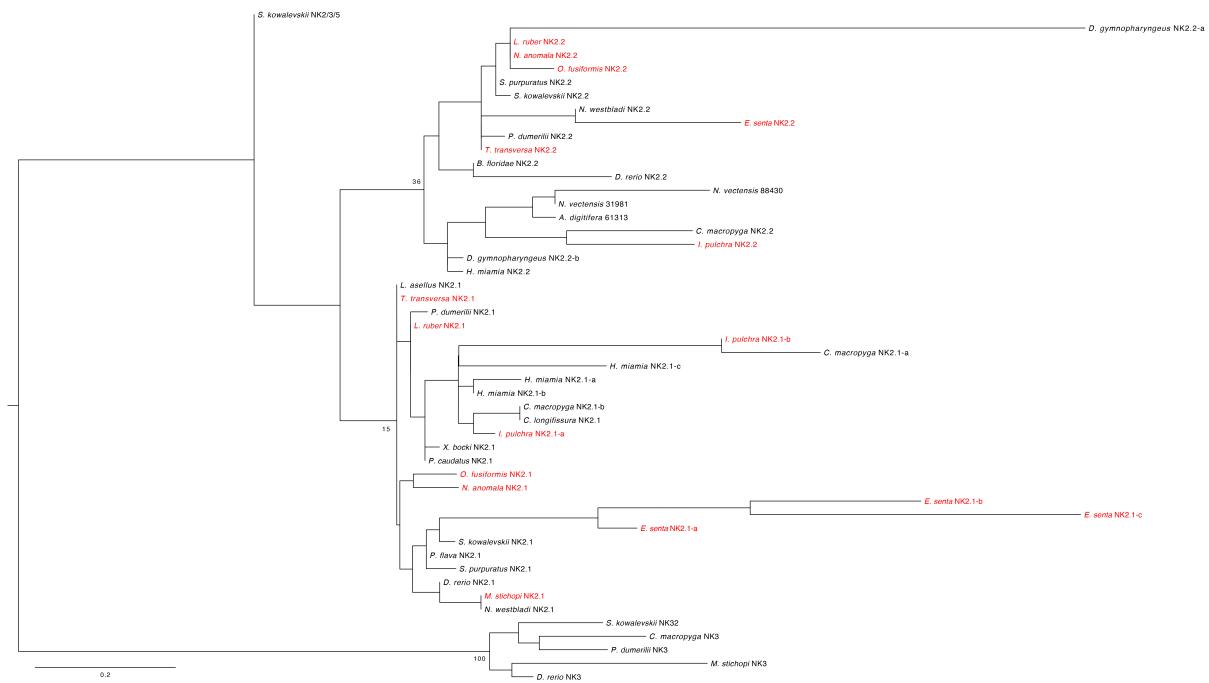


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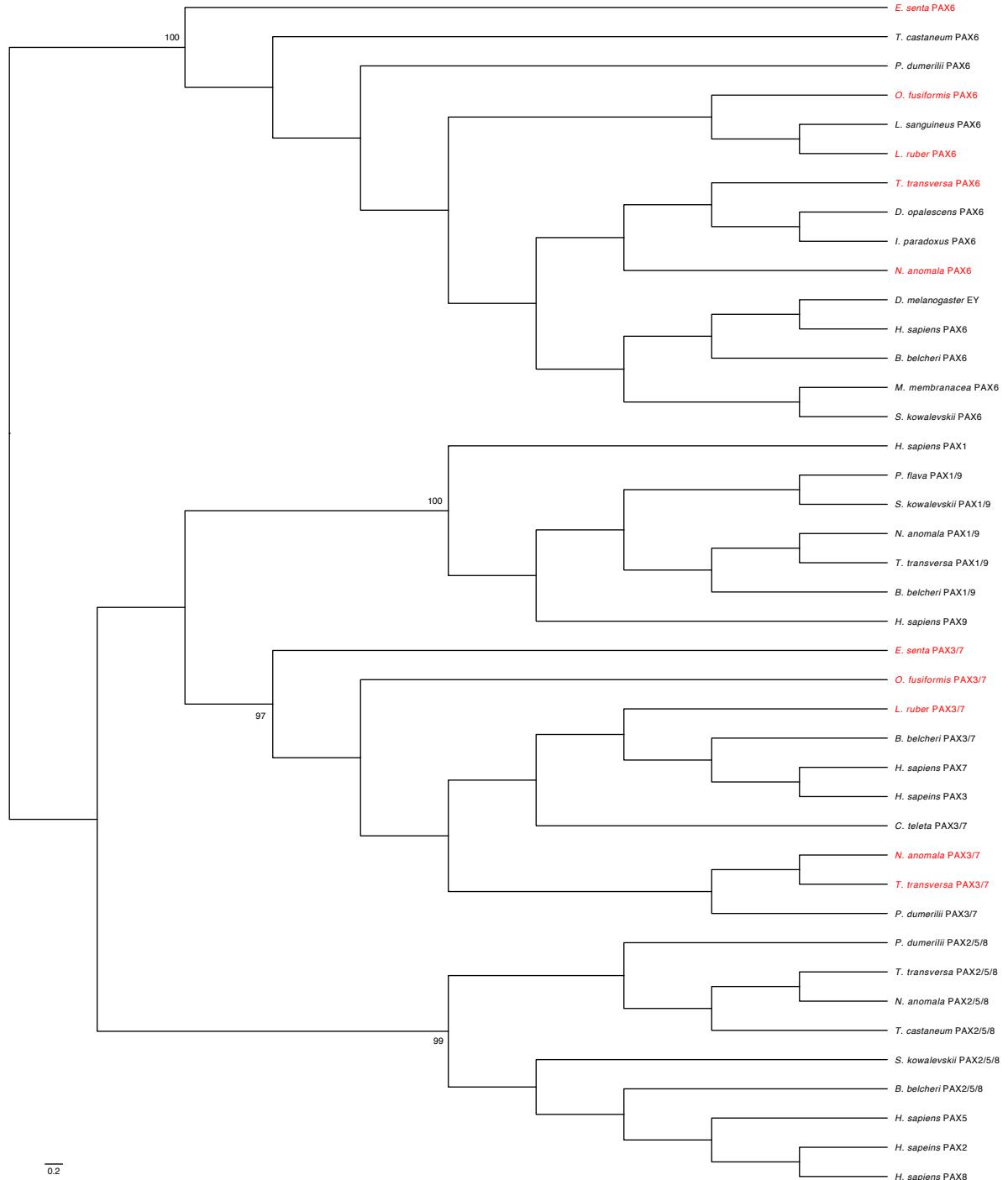


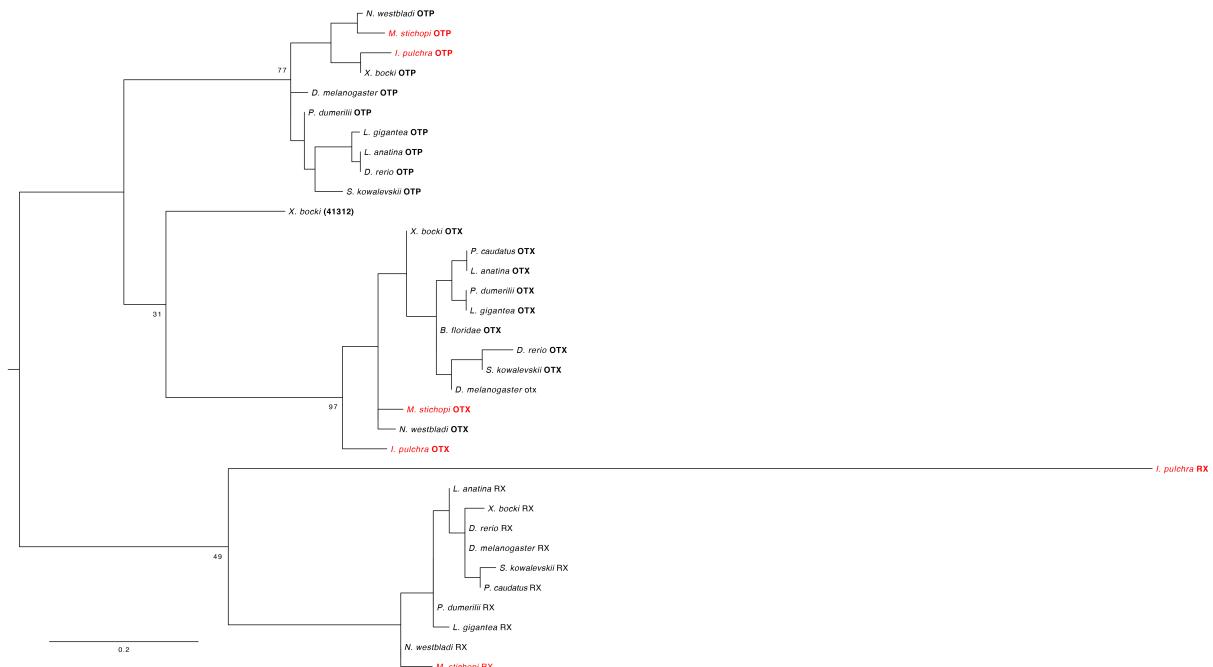
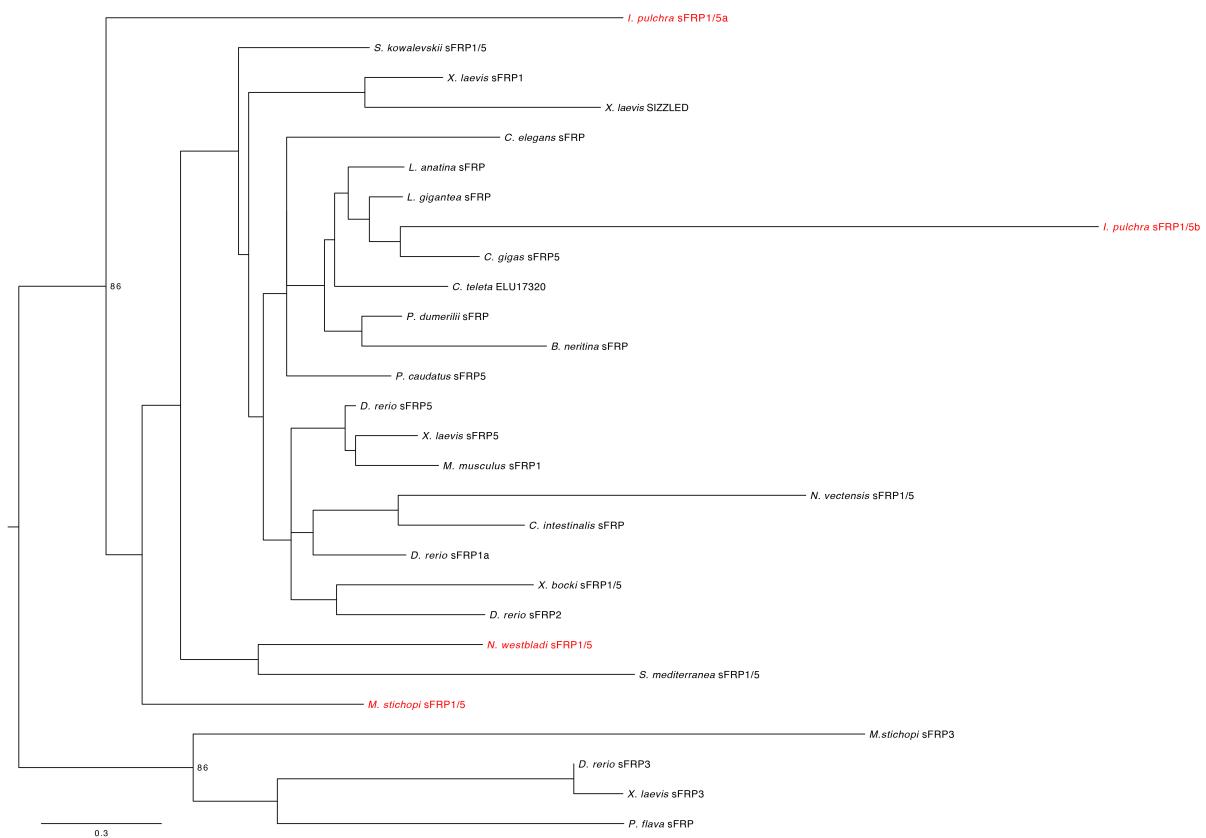
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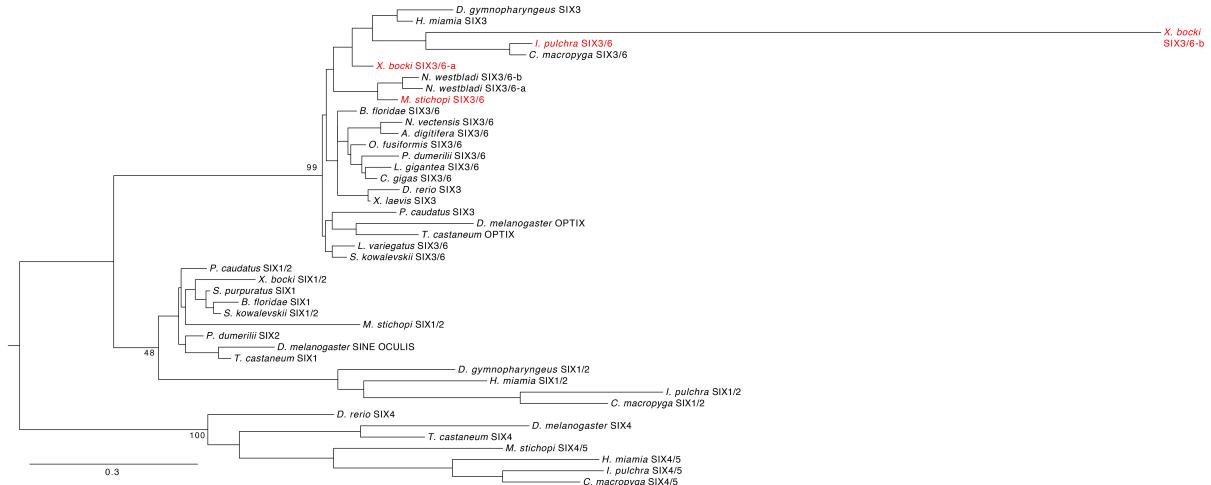
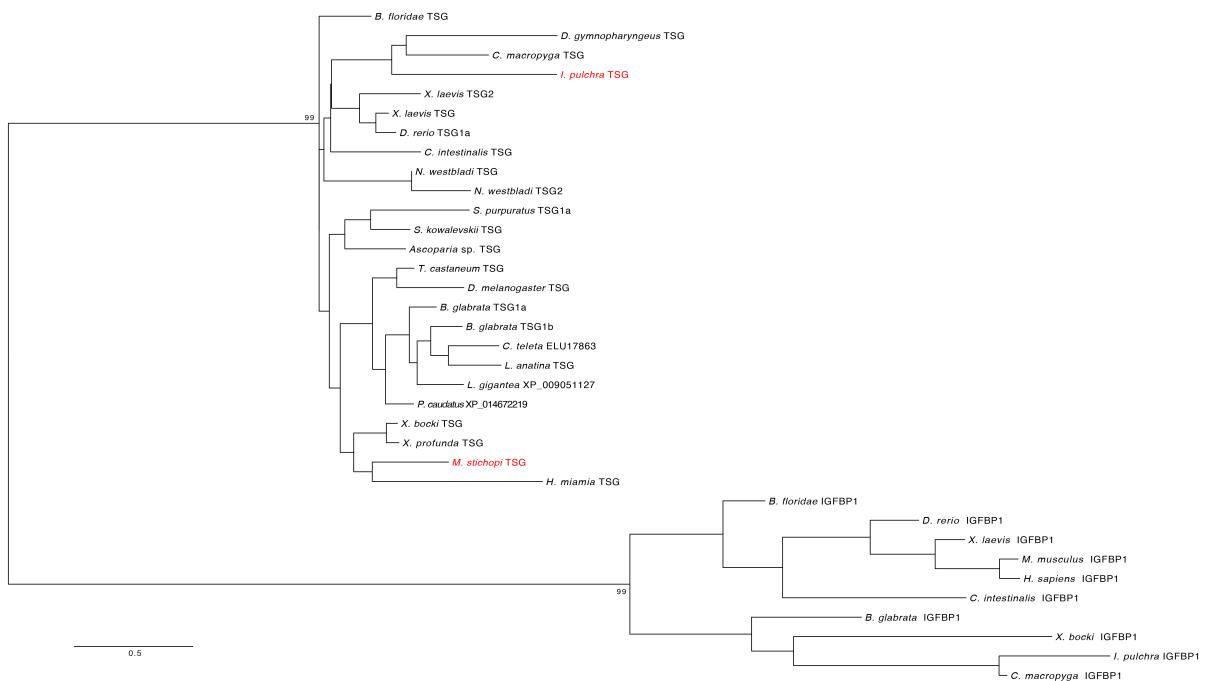
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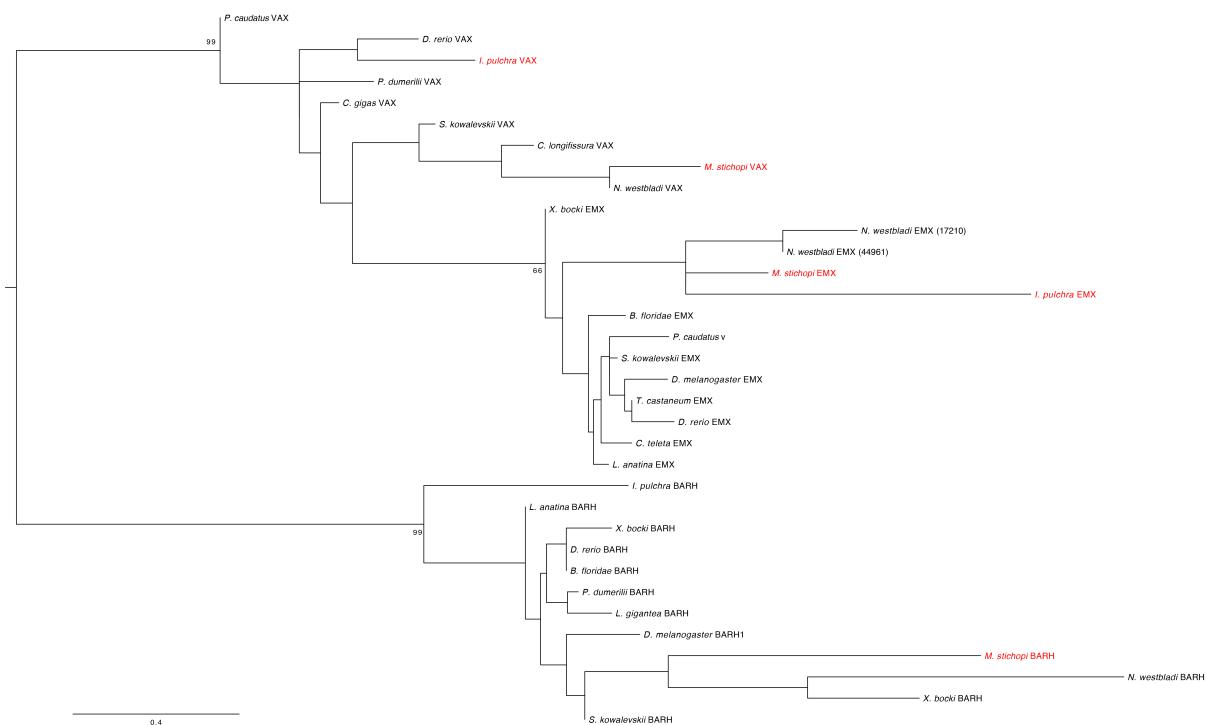
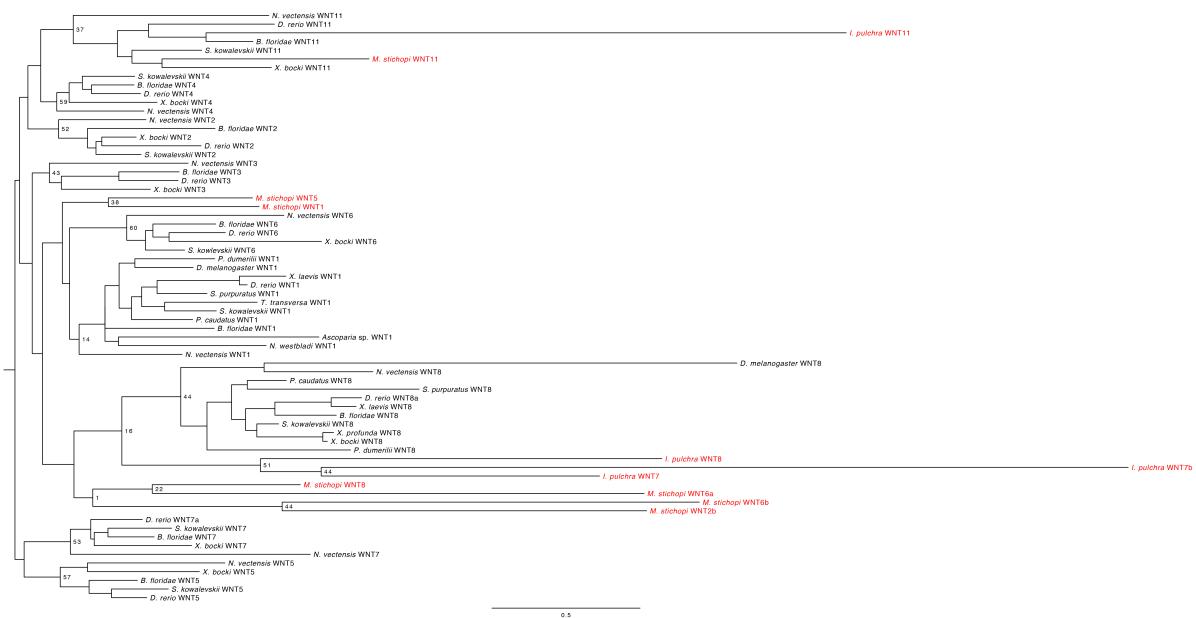
g

h



i**j**

k**l**

m**n**

Supplementary Figure 1 | Orthology analyses. (a–n) Maximum likelihood phylogenetic trees. Only bootstrap values at the nodes supporting orthology of gene families are shown. Sequences analysed in this study are in red.

Supplementary Table 1 | Gene complement in *M. stichopi* and *I. pulchra*

Gene orthogroup	<i>M. stichopi</i>	<i>I. pulchra</i>
<i>sFRP1/5</i>	<i>sFRP1/5</i>	<i>sFRP1/5a, sFRP1/5b</i>
<i>vax</i>	<i>vax</i>	<i>vax</i>
<i>six3/6</i>	<i>six3/6</i>	<i>six3/6</i>
<i>BarH</i>	<i>BarH</i>	<i>BarH</i>
<i>emx</i>	<i>emx</i>	<i>emx</i>
<i>Rx</i>	<i>Rx</i>	<i>Rx</i>
<i>otx</i>	<i>otx</i>	<i>otx</i>
<i>otp</i>	<i>otp</i>	<i>otp</i>
<i>pax2/5/8</i>	<i>pax2/5/8</i>	<i>pax2/5/8-a, pax2/5/8-b</i>
<i>pax6</i>	<i>pax6</i>	<i>pax6</i>
<i>pax3/7</i>	-	-
<i>fez</i>	<i>fezf</i>	<i>fezf</i>
<i>irx</i>	<i>irx4, irx6</i>	<i>irx6-a, irx6-b, irx3/4, irx5</i>
<i>gbx</i>	<i>gbx</i>	-
wnt ligand	<i>wnt-1, wnt-6a, wnt-6b, wnt-8, wnt-11, wnt-5, wnt-2b</i>	<i>wnt-8, wnt-6, wnt-7, wnt-7b, wnt-5, wnt-16</i>
<i>bmp</i> ligand	<i>bmp2/4, bmp5/8</i>	<i>bmp2/4, bmp5/8</i>
<i>tsg</i>	<i>tsg</i>	<i>tsg</i>
<i>cv2</i>	<i>cv2</i>	-
<i>admp</i>	<i>admp, admp (1790)</i>	<i>admp-a, admp-b</i>
<i>chd</i>	<i>chd</i>	<i>chd</i>
<i>BAMBI</i>	<i>BAMBI</i>	-
<i>tld</i>	<i>tld</i>	<i>tld</i>
<i>bmp</i> Receptor	<i>bmpR-I, bmpR-II</i>	<i>bmpR-I, bmpR-II</i>
<i>smad</i>	<i>smad1, smad4, smad6</i>	<i>smad1, smad4, smad6</i>
<i>nkx2.1</i>	<i>nkx2.1</i>	<i>nkx2.1-a, nkx2.1-b</i>
<i>nkx2.2</i>	-	<i>nkx2.2</i>
<i>nkx6</i>	<i>nkx6</i>	<i>nkx6</i>
<i>msx</i>	<i>msx</i>	<i>msx</i>
<i>elav</i>	<i>elav1, elav2</i>	<i>elav1, elav2</i>
<i>soxB</i>	<i>soxB2, soxB1</i>	<i>soxB</i>
<i>ash</i>	<i>ash1, ash2</i>	<i>ash1b, ash1a</i>
<i>ataonal</i>	<i>ataonal</i>	-
<i>neuroD</i>	<i>neuroD</i>	<i>neuroD</i>

In green, genes with reported *in situ* pattern; in red, genes with no observed/reported *in situ* signal.

Supplementary Table 2 | Expression of dorsoventral transcription factors previously reported in major lineages of Bilateria

	<i>nkx2.1</i>	<i>nkx2.2</i>	<i>nkx6</i>	<i>pax6</i> – ⁴	<i>pax3/7</i>	<i>msx</i>
Cnidaria	Inner pharynx ¹	Pharynx, endoderm ^{2,3}	Pharynx ectoderm ³	– ⁴	Tentacle ectoderm, capitulum ⁴	Oral ectoderm ² ; endoderm ⁵
Acoela	Anterior nervous system, ventro-posterior ectoderm ⁶	?	?	Lateral margin ⁷		?
Vertebrata ^a	Medial anterior neural plate (hypothalamus) ⁸	Late ventral neural tube ⁹	Medial neuroectoderm ¹⁰	Brain, spinal cord, eyes ^{11,12}	Lateral neural plate, brain ¹³	Lateral neuroectoderm, eye, sensory organs ¹⁴
Urochordata	Endoderm ¹⁵	–	Visceral motor ganglion ¹⁶	Neural plate, anterior brain, posterior neural tube ¹⁷	Lateral neural plate, brain, posterior neural tube ¹⁷	Neural plate border and tube, otolith, ocellus, ventral epidermis ^{18,19}
Cephalochordata	Medial neural plate, endoderm, CNS, endostyle ²⁰	Endoderm, anterior neural tube, cerebral vesicle ²¹	?	Anterior neural plate and tube, cerebral vesicle, frontal eye ²²	Endoderm, mesoderm, lateral neural plate ²³	Lateral neural plate, corpuscles of Quatrefages ²⁴
Hemichordata	Ventral prosome ectoderm, pharyngeal endoderm ²⁵	Endoderm ²⁶	?	Prosome, mesosome and anterior metasome ^{25,27}	?	Metasome ectoderm ²⁶
Echinodermata	Apical plate ectoderm ²⁸	Aboral ectoderm ²⁹	Endoderm ³⁰	Tube feet ³¹	–	Oral ectoderm, gut ³²
Priapulida	Oral ectoderm ³³	?	?	?	?	?
Nematoda	?	Pharyngeal muscles ³⁴	Reproductive system ³⁵	Head epidermis and neurons, gonadal tip cell, male tale ^{36,37}	Ventral P hypodermal cells ³⁸	Touch cell precursors ³⁹ , lateral sensory cells ⁴⁰
Arthropoda ^b	–	Medial neuroectoderm, midgut ⁴¹	Nerve cord midline, motoneurons ¹⁰	Eye, brain, ventral nerve cord ⁴²	Ectodermal segmentation ⁴³	Lateral neuroectoderm ⁴⁴
Platyhelminthes	Medial planarian brain ⁴⁵	Gut ⁴⁶	Medial brain region ⁴⁵	Brain and ventral nerve cords ^{45,47,48}	Ventral brain midline and nerve cords ⁴⁵	Anterodorsal regenerating midline, regenerating eyes, scattered cells ⁴⁹
Mollusca	Anterior cerebro-optic neuroectoderm ⁵⁰	?	?	Arms, eye, optic lobe, brain, mantle, ventral nerve cord ⁵⁰⁻⁵⁴	Optic area, funnel and mantle ectoderm, dorsal arm ectoderm ⁵⁰	Branchial and stellate mantle ganglia ⁵⁰
Annelida	Prostomium, brain, gut, mesoderm ^{55,56}	Midline neuroectoderm ⁵⁷	Mediolateral neuroectoderm ⁵⁷	Lateral neuroectoderm, CNS, eye ^{57,58}	Lateral neuroectoderm, mesoderm, nephridia, PGZ ^{57,59,60}	Lateral neuroectoderm, forming segments, CNS, nephridia ^{57,61,62}
Brachiopoda	Apical ectoderm, mouth ⁶³	Ventral trunk midline, posterior end, gut	Ventral trunk midline, posterior end, gut, apical lobe ectoderm	Apical lobe ectoderm ⁶⁴	Anterolateral trunk ectoderm	Mantle lobe, shell epithelium

^aexpression for *Danio rerio*; ^bexpression for *Drosophila melanogaster*; Expression reported in this study is in red.

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